CLAIMS:

1. A method of determining temperature of an object by remote sensing, comprising:

- acquiring electromagnetic radiation data from the object in N spectral bands,

- deriving temperature value from said data using a system of equations, each describing the electromagnetic radiation that is emitted from the object in said band as a function of temperature and emissivity of the object;

the method being characterized in that,

- said electromagnetic radiation is measured M times, each time in N said spectral bands, thus obtaining N*M readings,

- a system of N*M equations is formed, each describing the electromagnetic radiation that is emitted from the object in said band as a function of temperature T and emissivity ε of the object, wherein the emissivity ε is a function of at least two arguments being temperature T and wavelength λ; said system comprising N*M readings of the electromagnetic radiation and M+P unknowns which include M values of the object's temperature corresponding to said respective M measurements of the electromagnetic radiation, and P parameters, wherein $P \geq 2$; said parameters belonging to a selected mathematical form of the emissivity function;

- solving said system of N*M equations, thus deriving temperature of the object at any one of the M moments of said electromagnetic radiation measurement, wherein M is a natural number of the set [1, 2, 3...].

2. A method of determining emissivity function of an object by remote sensing, comprising

- acquiring electromagnetic radiation data from the object in N spectral bands by measuring it M times, each time in N said spectral bands, thus obtaining N*M readings,

- forming a system of N*M equations, each describing the electromagnetic radiation that is emitted from the object in one of said bands as a function of temperature T and emissivity ε of the object. wherein the emissivity ε is a function of at least two arguments being temperature T and wavelength λ; said system comprising N*M readings of the electromagnetic radiation and M+P unknowns including M values of the object's temperature corresponding to said respective M measurements of the electromagnetic radiation, and P parameters, wherein $P \geq 2$; said parameters belonging to a selected mathematical form of the emissivity function;

- solving said system of N*M equations to derive said P parameters, thereby restoring the emissivity function of the object.

3. The method according to Claim 1 or 2, comprising:

- selecting said emissivity function to take constant values within respective spectral bands thus considering P equal to N, and
- forming said system of N*M equations to comprise N*M readings of the electromagnetic radiation and M+N unknowns; said M+N unknowns including M values of the object's temperature corresponding to said respective M measurements of the electromagnetic radiation and N values of emissivity for said respective N spectral bands.

4. The method according to any one of the preceding claims, wherein each reading obtained from said M measurements of the electromagnetic radiation in N spectral bands is digitized and stored in a computer memory for further computerized processing, said processing comprising substituting the digitized M*N readings of the electromagnetic radiation into said M*N equations, and solving thereof.

5. The method according to any one of the preceding claims, wherein said measurements are provided in the infrared spectrum.

6. The method according to any one of the preceding claims, wherein said equations are integral.

7. The method according to Claim 6, wherein said equations are Fredholm equations relating to emissivity.

8. The method according to Claim 6 or 7, wherein each of said M*N equations describes the electromagnetic radiation that is emitted from the object in one of said bands as a function of the temperature and the respective emissivity of the object, the emissivity, in turn, being a known function of temperature, wavelength and a known number of unknown parameters: said parameters being introduced as additional unknowns into said system of equations for further obtaining their values upon solving the system.

9. The method according to Claim 8, wherein said known function is represented as a sum of a known number of terms of two other functions, a first of which being dependent only on temperature and a known number of unknown parameters, and a second being dependent only on wavelength.

10. The method according to Claim 8, wherein said known function is represented by a polynomial expansion having K unknown coefficients, said coefficients being introduced into the system of equations as unknown parameters to be determined among said unknowns upon solving said system.

11. The method according to any one of claims 1, 8 to 10, for non-contact temperature measurement of heated semiconductor materials and samples

during manufacture thereof.

12. The method according to any one of the preceding claims, intended for deriving temperature and/or emissivity descriptive maps of the object, wherein the temperature and/or emissivity is determined with respect to a pre-selected plurality of representative segments of the object, and mapping each of the determined values to a respective pixel of said descriptive map.

13. The method according to Claim 12, wherein the object comprises a plurality of sub-objects having different temperatures and/or emissivities and dislocated in a selected region.

14. The method according to Claim 13, for detection said sub-objects with a background of the ground and surrounding atmosphere, comprising the steps of:

- acquiring meteorological data indicative of climatic conditions of the selected region on the ground and/or the surrounding atmosphere;
- recording the acquired electromagnetic radiation and meteorological data by means of suitable data recording means;
- storing the so-recorded data in suitable data storage means and deriving from the so-stored data, descriptive maps of the selected region; and
- feeding data of said descriptive maps into pattern recognition processor means to classify the pixels of said maps of said selected region, whereby the desired object detection is achieved.

15. The method according to Claim 14, wherein said meteorological data are obtained from meteorological stations.

16. The method according to Claim 14 or 15, comprising providing a single

scanning pass of the selected region (i.e. M=1) for the detection if a pronounced temperature and/or emissivity differential is revealed for representative segments of the object.

17. The method according to Claim 14 or 15, wherein said descriptive maps describe temperature, emissivity and albedo, wherefrom a set of characteristic maps of the selected region are derived by incorporating suitable reference data.

18. The method according to Claim 17, wherein an optimal set of characteristic maps of the selected region is chosen.

19. The method according to any one of Claims 14 to 18, wherein the pixel classification comprises defining a number of classes and associating the pixels in the selected region with said classes.

20. The method according to any one of Claims 14 to 19, wherein a quality function is defined and the pattern recognition process entails determining that set of characteristic maps that makes the quality function maximal.

21. The method of any one of Claims 14 to 20, wherein the acquisition of electromagnetic radiation is performed by near range scanning.

22. The method of any one of Claims 14 to 20, wherein the acquisition of electromagnetic radiation is performed by remote scanning.

23. The method of any one of Claims 14 to 22, wherein the scanning of the selected region is performed with at least five ground oriented sensors operating, respectively, in the 3-4 μ, 4-5 μ, 8-10 μ, 10-12 μ and the near

infrared and visible spectral bands, and there is provided at least one further sensor for measuring electromagnetic radiation from the space above, operating in the 0.4-2 μ spectral band.

24. The method according to any one of Claims 14 to 23, wherein said classifying processor means in which the pixels of the characteristic maps of the selected region are classified into classes, makes use of a poly-Gauss expansion to describe the statistical distribution of the pixels and Bayes' method to sort the pixels into classes.

25. The method according to Claims 14 to 24, wherein said pattern recognition processor means also include additional geometrical classification means for determining the shape of the detected object.

26. The method according to any one of Claims 14 to 25, adapted for real time temperature and/or emissivity mapping of a plurality of selected regions to be observed, wherein the step of acquisition of said electromagnetic radiation data is provided in real time by equipment mounted on a movable platform while displacing along said plurality of selected regions; and wherein the steps of recording and storing the acquired electromagnetic radiation and meteorological data and further deriving, from the so-stored data, descriptive maps of the selected region are registered with the platform displacement.

27. The method according to Claim 26, comprising automatic recognition of objects positioned along or on the course of the moving platform.

28. The method according to Claim 27, additionally comprising initiating an alarm and automatic adjusting the course of the vehicle whenever an obstacle

is recognized.

29. A system for remotely determining temperature and/or emissivity function of an object, said system comprising:

scanning means for acquiring electromagnetic radiation data from the object M times, each time in N spectral bands, thus obtaining N*M readings of the electromagnetic radiation, wherein M is a natural number of the set [1, 2, 3 ...];

means for recording and storage said N*M readings in the digital form:

computational means for processing said N*M readings of the electromagnetic radiation as a system of N*M equations comprising M unknown values of temperature and at least P unknown parameters. wherein $P \geq 2$: said parameters belonging to a selected mathematical form of the object's emissivity function (ε) of at least two arguments being temperature T and wavelength λ;

display means for displaying one or more of said unknowns obtained upon solving said system of equations. or derivatives therefrom.

30. The system according to Claim 29, wherein said scanning means are capable of acquiring the electromagnetic radiation from a plurality of representative segments of the object, and said computational means are capable of processing the acquired data, for deriving and displaying temperature and/or emissivity descriptive maps of the object.

31. The system according to Claim 29 or 30, wherein said scanning means comprise a plurality of sensors capable of simultaneously measuring electromagnetic radiation in a number of spectral bands.

32. The system according to Claim 29 to 30, wherein the scanning means comprise a spatial optical filter divided into a number of sites for simultaneous acquiring the electromagnetic radiation from said plurality of respectively located segments of the object; each said site having N zones responsible for splitting the radiation acquired by the site into N spectral bands, thereby acquiring the electromagnetic radiation in all N spectral bands simultaneously.

33. The system according to Claim 29 or 30, wherein the scanning means comprise a rotatable optical filter for acquiring electromagnetic radiation in said N spectral bands in sequence.

34. The system according to any one of the Claims 29 to 33, wherein said scanning means are capable of remote scanning.

35. The system according to any one of the Claims 29 to 33, wherein said scanning means are designed for close range scanning.

36. The system according to any on of Claims 29 to 35, wherein said scanning means comprise at least five ground oriented sensors operating, respectively, in the 3-4μ, 4-5 μ, 8-10 μ, 10-12 μ and the near infrared and visible spectral bands and at least one space oriented sensor operating in the 0.4-2 μ spectral band.

37. The system according to any one of Claims 29 to 36, capable of object detecting in a selected region having a background including the ground and/or the surrounding atmosphere, further comprising:

- means for acquiring meteorological data indicative of climatic conditions of the selected region and the surroundings;

- means for recording said meteorological data;

- data storage means for storing the recorded meteorological data;

-computational means for deriving from the stored metheorological data and the data on the electromagnetic radiation, descriptive maps of the selected region; and

- pattern recognition processor means for classifying the pixels of said maps.

38. The system according to Claim 37, wherein said means for acquiring meteorological data are associated with meteorological stations.

39. The system according to Claims 37 or 38, wherein said computational means are capable of deriving from said descriptive maps a set of characteristic maps.

40. The system according to Claim 37 to 39, wherein said processor means comprise optimizing means for selecting an optimal set of characteristic maps which is subjected to pixel classification.

41. The system according to any one of Claims 37 to 40, wherein the pattern recognition processor means comprises pixel classification means in which a number of classes is defined whereby the classified pixels are statistically associated with the classes.

42. The system according to any one of Claims 37 to 41, wherein the pattern recognition processor means is capable of functioning based on a poly-Gauss expansion for determining the statistical distribution of the pixels, and means based on Bayes's method for sorting pixels into classes.

43. The system according to any one of Claims 37 to 42, wherein said

pattern recognition processor means comprises quality factor evaluation means.

44. The system according to any one of Claims 37 to 43, wherein the pattern recognition processor means includes additional geometrical classification means for determining the shape of the detected object.

45. The system according to any one of Claims 37 to 44, wherein the scanning means and the data recording means are positioned on any movable platform, whereas the data storage means, computational means, classification means and pattern recognition means are placed on the ground.

46. The system according to any one of Claims 37 to 44, being portable and mountable on a movable platform.

47. The system according to Claim 45 or 46, wherein said computational means are adapted to register the recorded and stored data of the acquired electromagnetic radiation with the platform's movement to obtain a real time mapping and pattern recognition.

48. The system according to any one of Claims 45 to 47, wherein said pattern recognition processor means are capable of automatic recognition of objects positioned along or on the course of the moving platform.

49. The system according to Claim 48, additionally comprising means for initiating an alarm.

50. The method according to any one of Claims 14, 15, 17 to 26, for detection of underground structures, comprising extracting from the recorded

data physical information characterizing heating and cooling processes that take place at the ground surface and below it by applying an equation of energy balance and a set of thermophysical constants. processing said information for detecting regions having different thermal properties, in the region selected for scanning, and classifying thus revealed thermophysical inhomogeneous regions by said pattern recognition processor means, thereby identifying the underground structures.

51. The method according to Claim 50, comprising derivation of the descriptive and characteristic maps based on Planck's equation, describing the electromagnetic radiation that is emitted from and reflected by the ground.

52. The method according to Claim 51, wherein said characteristic maps comprise maps of thermal inertia, thermal flux, coefficient of heat transfer and coefficient of mass transfer.

53. The system according to Claims 37 to 47, wherein said pattern recognition processor means are capable of extracting from the recorded data physical information characterizing heating and cooling processes that take place at the ground surface and below it by applying an equation of energy balance and a set of thermophysical constants. processing said information for detecting regions having different thermal properties, in the region selected for scanning, and classifying thus revealed thermophysical inhomogeneous regions, thereby enabling identifying and displaying the underground structures.